

**Bio Clean Dual Stage Hydrodynamic Separator General
Information**
(Vortex Separator with Elevated Screen System)

DUAL STAGE

Hydrodynamic Separator (NSBB)

PROVEN STORMWATER TREATMENT TECHNOLOGY



Overview

The Bio Clean Nutrient Separating Baffle Box (NSBB) is an advanced stormwater treatment system utilizing screening and hydrodynamic separation to capture pollutants.

The patented screening system, suspended above the sedimentation chambers, captures and stores trash and debris in a dry state. Dry state storage of trash and debris minimizes nutrient leaching, bacteria growth, bad odors and allows for easier removal.

The NSBB's triple chamber design provides higher removals of total suspended solids over a wide range of particle sizes, including the finest particles. Fine sediments carry large amounts of heavy metals, nutrients and other harmful pollutants.

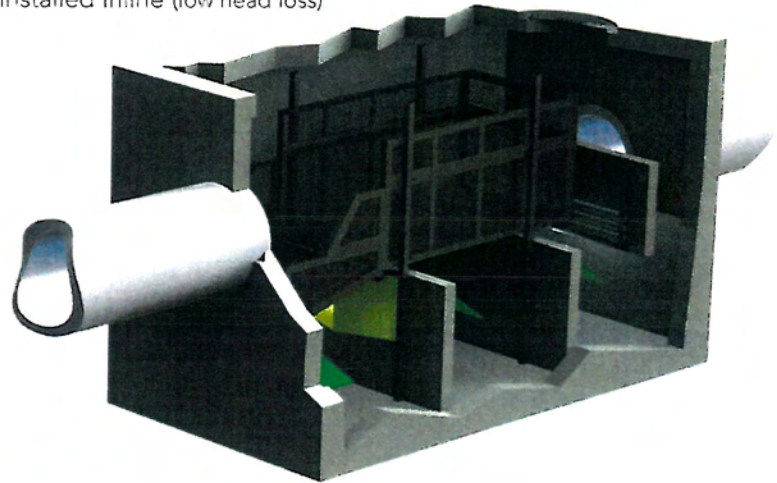
The patented deflector shield system ensures no scouring of captured sediments during high flow. This feature allows the system to be installed inline, thus eliminating the need for diversion structures. The oil skimmer with hydrocarbon booms traps and absorbs oil into a polymer based media for permanent removal.

In use since 1994, it is a widely accepted stormwater treatment solution among civil engineers, municipalities and developers nationwide.

www.BioCleanEnvironmental.com

Advantages

- Dual Stage Treatment (Screening & Separation)
- Enhanced 3 Chambered Separation
- Proven Not to Scour
- Separates Trash & Debris from Sediment & Water
- Easily Installed Inline (low head loss)



Performance

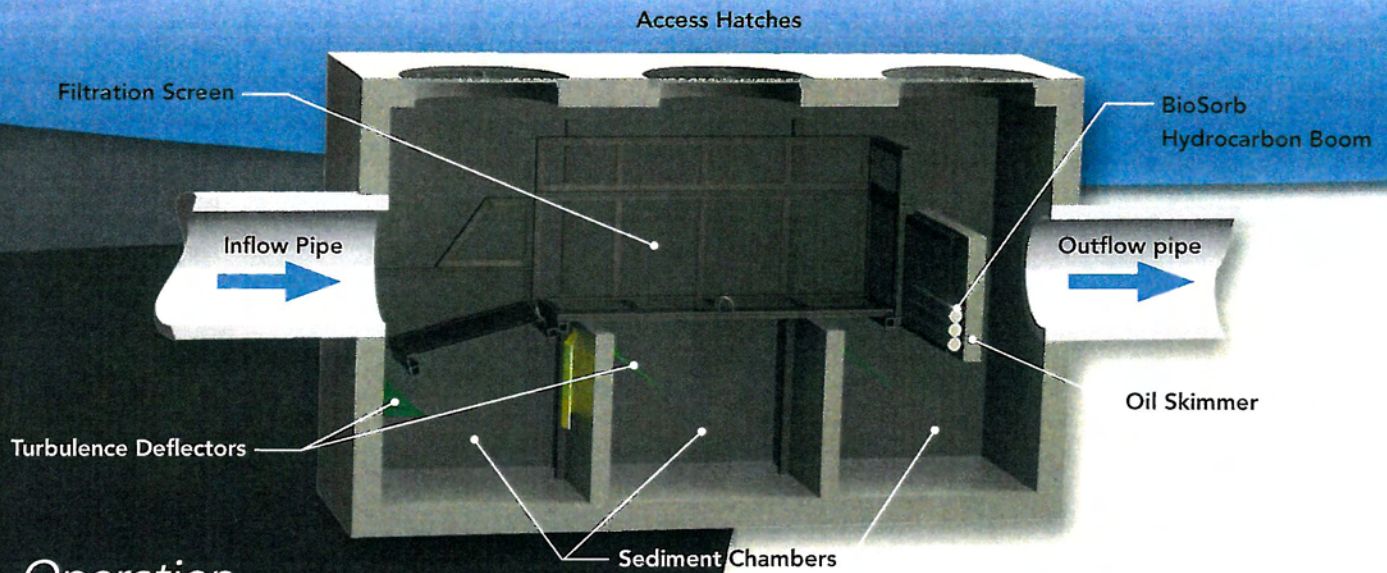
- 87% Removal of TSS
- 99% Removal of Oils & Grease
- 71% Removal of Turbidity
- 40% Removal of Copper
- Up to 47% Removal of Bacteria

Specifications

Model #	Surface Loading Area (sq. ft.)	Storage Capacity (cu. ft.)
NSBB-2.5-4-60	10	26
NSBB-3-6-72	18	60
NSBB-4-6.5-72	26	90
NSBB-4-8-84	32	114
NSBB-5-10.5-84	52.5	179
NSBB-6-12-84	72	267
NSBB-8-12-84	96	360
NSBB-8-14-96	112	458
NSBB-10-14-96	140	582
NSBB-11-16-114	176	857

Screen System + Sediment Chambers

DUAL STAGE Hydrodynamic Separator (NSBB)

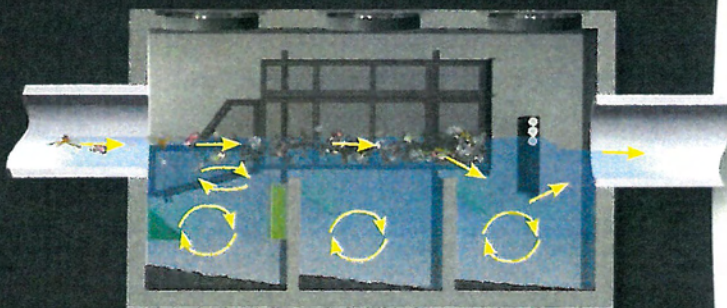


Operation

- **Filtration Screen**– Collects and stores trash, debris, organics, and oxygen demanding substances above standing water in a dry state.
- **Turbulence Deflectors**– Prevents re-suspension of captured pollutants.

- **Sediment Chambers**– Maximizes TSS removal and eliminates scouring during extreme flow rates.
- **Skimmer & Boom**- Collects hydrocarbons & controls flow velocity which improves removal efficiency.

During Storm Events



Trash, debris & organics are captured in the filtration screen as sediments settle to the bottom chambers. Hydrocarbons are removed and absorbed by the boom.

Between Storm Events



Trash, debris & organics are stored in a suspended screen system allowing pollutants to dry out between storm events. This eliminates septic conditions and prevents leaching of plant based organics into water.

PROVEN STORMWATER TREATMENT TECHNOLOGY

PRETREATMENT & DIVERSION

High Flow Bypass Pipe

Inflow Pipe

Underground Infiltration /Storage Chambers

Low Flow (First Flush) Diversion

Application

- Commercial
- Residential
- Retrofit
- Pretreatment for:
 - Reuse Systems
 - Infiltration Basins
 - Bioretention & Swales
 - Detention Basins
 - Wet Ponds
 - Media Filters

Built-In Diversion Eliminates the Need for Diversion Structures

RETROFIT & NEW CONSTRUCTION



Lake Tahoe, CA

Installation



Low Pick Weights
Delivered in a top & bottom to minimize weight



1 Hour Set Time
Internal components are installed prior to delivery

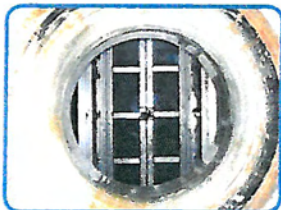


Minimal Excavation
Bottom of structure less than 4 ft. from invert of pipe



Maintenance

- No confined space entry is required for servicing
- Cleaning can be accessed through manhole or hatch above ground with vac truck
- Separating pollutants minimizes costs - screen system allows gross solids to be removed without vacuuming out water or sediment chambers
- Screen systems are hinged for easy access to sediments collected in lower chambers



DESIGNED FOR USE WITH STANDARD VACUUM TRUCKS

DUAL STAGE

Hydrodynamic Separator (NSBB)

PROVEN STORMWATER TREATMENT TECHNOLOGY

Approvals



USING NJ CAT RECOMMENDED PSD (67 MICRONS μ)

Comparison Results

BIO CLEAN Hydrodynamic Separator (NSBB)



Stores trash, debris & organics in screening system separated from water below.

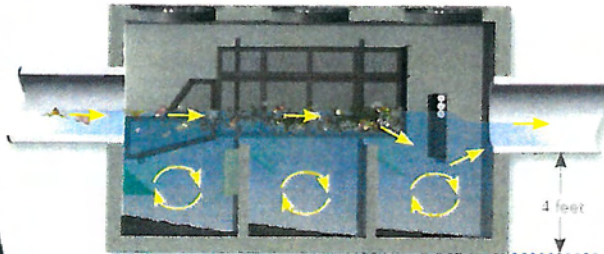


Separation Prevents:

- Odor
- Bacteria Growth
- Nutrient Leaching
- Septic Conditions

Shallow Profile Minimizes Maintenance Cost

- Less Shoring
- Perfect for Areas with High Ground Water



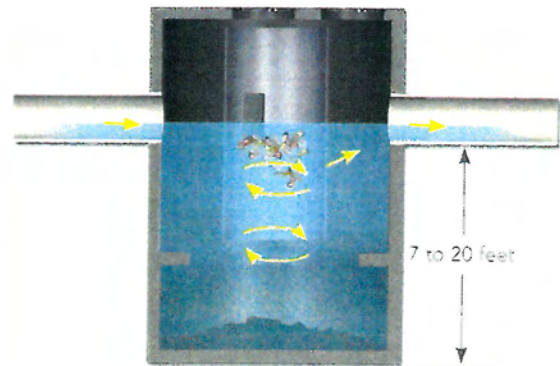
Other Separators

Trash, debris & organics are captured and stored in standing water.




This promotes nutrient leaching, bad odors, bacteria growth and complicates maintenance.

- High Excavation Cost
- Extra Shoring
- Challenge with Shallow Ground Water



2972 San Luis Rey Rd
Oceanside, CA 92058
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www.BioCleanEnvironmental.com



Modular Wetland System General Information
(Media Filter & Wetland/Bioretenention)

MWS-LINEAR 2.0 STORMWATER FILTRATION SYSTEM

NATURE AND TECHNOLOGY WORKING TOGETHER IN PERFECT HARMONY.

The need for a new stormwater treatment system is evident. Federal and state requirements on cities and industry to reduce stormwater runoff increase every year as our population explodes. The EPA is now reporting that stormwater runoff represents the nation's number one water quality problem, and is the reason why nearly half of our rivers and lakes are not even clean enough to support fishing or swimming. *Nearly half.*



To combat this catastrophe, we turned to the expert in this field: **Nature**. By developing technology that imitates the processes found in nature, we've created the most advanced stormwater filtration system available. Years ahead of current EPA requirements, our clients understand that when they invest in our new technology, they are investing in the future. For all of us.



MWS-LINEAR TESTED REMOVAL EFFICIENCIES

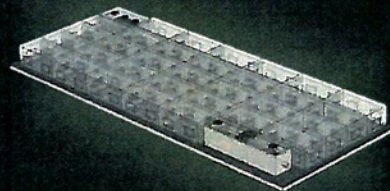
TSS	Nitrate	Copper	Zinc	Oils & Grease	Bacteria	Turbidity
82% - 98%	74%	>53% - 93%	79% - 81%	84% - 99%	60% - 89%	>90%

Washington State
DOE Approved

SIZING

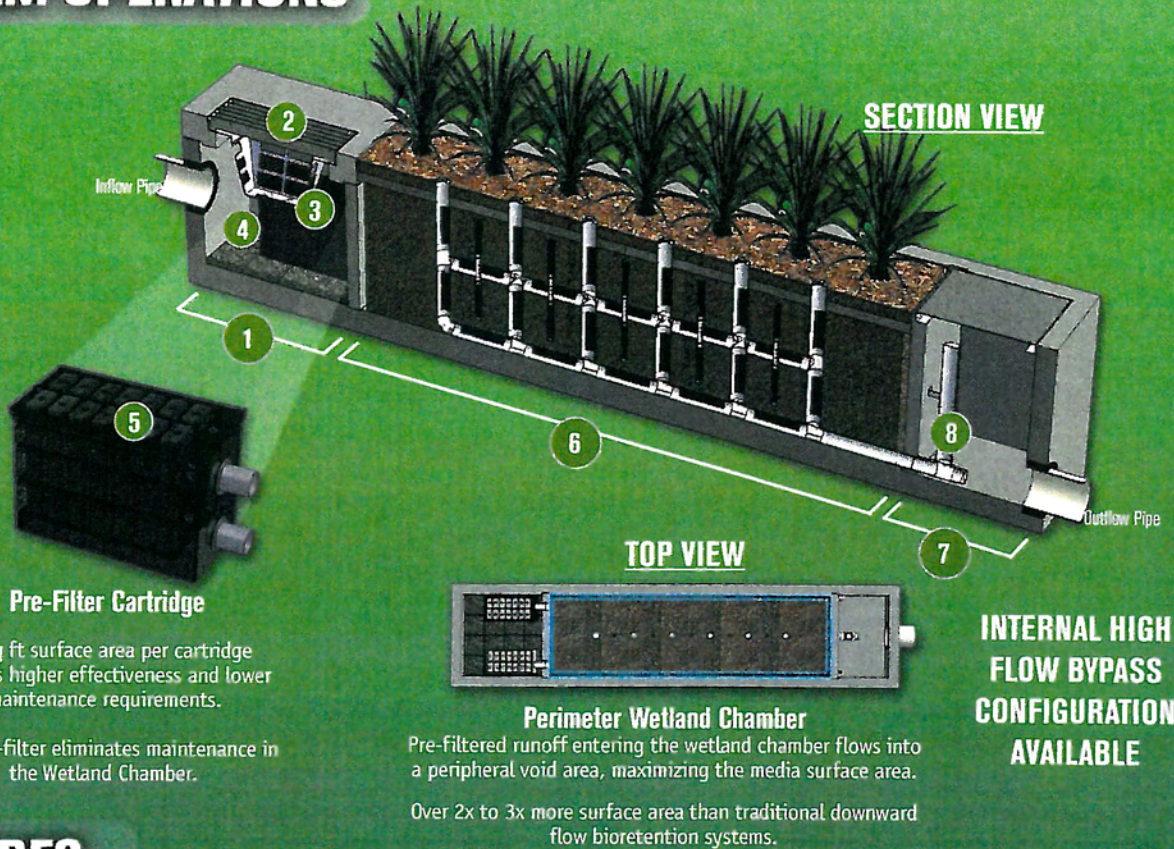
Model #	Dimensions (ft)	WetlandMedia Surface Area (sq ft)	Treatment Flow Rate (cfs)
MWS-L-3-6	3 x 6	34	0.076
MWS-L-4-8	4 x 8	50	0.116
MWS-L-4-13	4 x 13	63	0.144
MWS-L-4-15	4 x 15	76	0.175
MWS-L-4-17	4 x 17	90	0.206
MWS-L-4-19	4 x 19	103	0.236
MWS-L-4-21	4 x 21	117	0.267

VOLUME SIZING



The Modular Wetland System is the only biofilter that can be installed downstream of detention systems.

SYSTEM OPERATIONS



FEATURES


- 1 PRE-TREATMENT CHAMBER**
Captures incoming runoff and contains the first three stages of treatment.
- 2 GRATE TYPE CATCH BASIN INLET**
A standard 41" x 24" grate type traffic rated catch basin opening directs stormwater into the system.
- 3 CATCH BASIN INSERT FILTER**
Provides the first stage of treatment by capturing trash & litter, gross solids, and sediment.
- 4 SETTLING CHAMBER**
Provides the second stage of treatment by separating out larger suspended solids.
- 5 PRE-FILTER CARTRIDGE**
Provides the third stage of treatment by physically and chemically capturing fine TSS, metals, nutrients, and bacteria.
- 6 WETLAND CHAMBER**
Provides the final stage of treatment through a combination of physical, chemical and biological processes.
- 7 DISCHARGE CHAMBER**
Contains flow control, high flow bypass and optional drain down filter.
- 8 MULTI-LEVEL FLOW CONTROL**
Orifice plates and/or valves are used to control the flow through the treatment stages.



MODULAR
WETLANDS

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Bio Clean Dual Stage Hydrodynamic Separator Specifications
(Vortex Separator with Elevated Screen System)



Section [_____] Storm Water Treatment Device

PART 1 – GENERAL

01.01.00 Purpose

The purpose of this specification is to establish generally acceptable criteria for Storm Water Treatment Devices for treating storm water runoff including dry weather flows and other contaminated water sources. It is intended to serve as a guide to promote understanding regarding materials, manufacture and installation; and to identify devices complying with this specification.

01.02.00 Description

Storm Water Treatment Devices (SWTD) are used for filtration of stormwater runoff including dry weather flows. The SWTD is an inline pre-engineered hydrodynamic separation system composed of multiple sediment removal chambers, a screening system designed to capture and store solid debris such as foliage and litter in a dry state, and a skimmer system to remove floating pollutants.

01.03.00 Manufacturer

The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems developed for the treatment of stormwater runoff for at least (10) years, and which have a history of successful production, acceptable to the engineer of work. In accordance with the drawings, the SWTD(s) shall be a device manufactured by Bio Clean Environmental Services, Inc., or assigned distributors or licensees. Bio Clean Environmental Services, Inc. can be reached at:

Corporate Headquarters:
2972 San Luis Rey Road
Oceanside, CA 92058
Phone: (760) 433-7640
Fax: (760) 433-3176
www.biocleanenvironmental.net

01.04.00 Submittals

- 01.04.01 Submittal drawings are to be provided with each order to the contractor and consulting engineer.
- 01.04.02 Submittal drawings are to detail the SWTD and all components required and the sequence for installation, including:
 - System configuration with primary dimensions
 - Interior components
 - Any accessory equipment called out on submittal drawings
- 01.04.03 Inspection and maintenance documentation submitted upon request.

01.05.00 Work Included

- 01.05.01 Specification requirements for installation of SWTD.
- 01.05.02 Manufacturer to supply components of the SWTD(s):
 - Concrete structure (chambers)
 - Internal components
 - Risers, hatches, and manholes optional

01.06.00 Reference Standards

ASTM A 615	Standard Specifications for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM F 716.07	Standard Test Methods for Sorbent Performance of Absorbents
ASTM D 3787	Standard Test Method for Bursting Strength of Textiles-Constant-Rate-of- Traverse (CRT) Ball Burst Test

PART 2 – COMPONENTS

The Storm Water Treatment Device (SWTD) and all of its components shall be self-contained within a concrete structure constructed with a minimum 28 day compressive strength of 5,000 psi, with reinforcing per ASTM A 615, Grade 60, and supports a minimum H-20 loading as indicated by AASHTO. All seams and connection points shall be sealed water tight with non-shrink grout in accordance with manufactures recommendations and project specifications.

02.01.00 Screening System

- 02.01.01 Screen Frame shall be constructed of aluminum grade 6061-T6 and/or stainless steel grade 304. All joints and seams are to be welded or fastened together with aluminum and/or stainless steel hardware. All sides of screen frame shall be fixed. The top section of the screen frame shall have one of the following, open top, hinged top section, or a track guided sliding top section per drawings. The bottom section of the basket frame shall be a minimum of 3.5" above static water line and use a series of hinges to allow the bottom section to open to allow access to the sediment chambers located below in the lower portion of SWTD. The screen frame shall be located below the access hatches to allow access for maintenance. The screen frame shall be secured to the concrete baffle(s) with a minimum of 2 brackets and 4 bolts.
- 02.01.02 Screens shall be manufactured of flattened expanded stainless steel grade 304 and/or aluminum grade 6061-T6. As an alternate, the screen system may also be manufactured of perforated stainless steel or aluminum of the same grade mentioned previously. The screen shall be attached to the screen frame by sandwiching the screen to the screen frame between a series of aluminum or stainless steel angle beams and welded in place.

02.02.00 Skimmer System

The skimmer system shall be mounted to the skimmer wall and located between the end of the screening system and the outlet pipe. Skimmer wall shall be constructed of concrete with a minimum 28 day compressive strength of 5,000 psi, with reinforcing per ASTM A 615, Grade 60.

- 02.02.01 Storm Boom Housing shall be constructed of an aluminum grade 6061-T6 and/or stainless steel grade 304 frame with flattened expanded stainless steel grade 304 screen system. Housing shall have a hinged top section. Screen shall be attached to the Storm Boom Housing Frame by sandwiching the screen to the aluminum or stainless steel frame between a series of aluminum or stainless steel angle beams and welded in place. Storm Boom Housing shall be secured to the skimmer wall with aluminum or stainless steel hardware.

02.02.02

Storm Boom

- Storm Boom media shall be made of granulated oil absorbing polymers that have been tested in accordance with section 11.2 of ASTM F 716.07. Polymer granules must meet performance absorption standards in section 03.01.04.
- Boom netting shall be 100% polyester with a number 16 sieve size, and strength tested per ASTM D 3787.

02.03.00 Sediment Removal Chambers

02.03.01

Baffle Walls shall be constructed of concrete with a minimum 28 day compressive strength of 5,000 psi, with reinforcing per ASTM A 615, Grade 60.

02.03.02

Turbulence Deflectors shall be manufactured of 100% marine grade polyester resin and fiberglass strands and be mounted to the concrete baffles with stainless steel hardware. The turbulence deflectors should be sized to effectively eliminate scouring and re-suspension of previously captured sediments in the sediment removal chambers and creates a flow pattern that encourages suspended solids in influent flows to settle out and accumulate at the bottom of the SWTD.

- The all fiberglass deflectors must be coated with a polyester gel coating with ultra violet inhibitors incorporated into the coating for maximum ultra violet protection.
- Fiberglass must have a minimum thickness of 3/16".

PART 3 – PERFORMANCE

03.01.00 General

03.01.01

Function - The SWTD is a pre-engineered inline hydrodynamic separation system composed of multiple sediment removal chambers, a screening system designed to capture and store solid debris such as foliage and litter in a dry state above the static water line, and a skimmer system to capture oils, grease, and floating pollutants.

03.01.02

Removal Efficiencies - The SWTD shall be capable of achieving a minimum of 80% total suspended solids removal (of the size fractions typical for urban runoff) from the design flow rate. The SWTD must be capable of capturing and retaining 100% of all materials greater than or equal to a specific size as required by state and local regulations and at flow rates listed on submittal drawings. The SWTD shall be capable of capturing and retaining 90% of oils and grease. The SWTD shall not release material during flow events greater than the design flow rate. All removal efficiencies shall be tested in accordance with section 03.02.00.

03.01.03

Hydraulic Capacity - The SWTD shall provide a rated hydraulic capacity, which is consistent with governing water treatment regulations. The hydraulic capacity must be supported by independent third-party testing and verified by a nationally recognized testing protocol that is solely engaged in the promotion of emerging environmental technologies per section 03.02.01.

- 03.01.04 Storage Capacity - The SWTD must have multiple sediment removal chambers for storage of sediments and other non-floatable pollutants. The volume of each sediment removal chamber will be called out on the submittal drawings. The SWTD must have a skimmer to capture floatable pollutants. The skimmer shall be equipped with storm booms per section 02.02.02. The storm boom must be capable of capturing up to 180% of its weight in oils & grease along with other emulsified and free floating hydrocarbons and tested per section 03.02.03.
- 03.01.05 Pollution Separation - The SWTD must be equipped with a screening system capable of capturing and storing solid debris such as foliage and litter in a dry state above the static water line. The debris captured by the screening system must be stored a minimum of 3.5" above the static water line. The screening system must be located directly under the systems access hatch(s) to allow easy maintenance and removal of captured debris.

03.02.00 Test Performance

At a minimum, the SWTD must meet all of these testing performance standards and have a Manufactures Performance Certification per Section 05.02.00:

- 03.02.01 Independent Third Party Testing:
The SWTD must be tested and verified by a nationally recognized testing protocol and meet these testing standards;
- Approved by NJCAT, TAPE, TARP, or ETV.
 - Must use a particle size distribution with an average mean of 63 microns (5% clay / 40% silt / 55% sand). Testing must have been performed with the SWTD 50% pre-loaded with sediment.
 - At 50% and 100% storage capacity and 125 % treatment flow rate the SWTD must demonstrate no scouring of previously captured sediment.
- 03.02.02 Full Capture Approval - SWTD must have full capture approval by a city or government agency. Full capture is defined as 100% removal of all materials of a specific size as required by state and local regulations.
- 03.02.03 Oil and Grease Removal - The SWTD must be independently tested by a city or government agency to capture a minimum of 90% of all oils and grease along with other emulsified and free floating hydrocarbons.
- 03.02.01 Field Testing - The SWTD must be independently field tested by a city or government agency and demonstrated to remove a minimum of 80% TSS.

PART 4 - EXECUTION

04.01.00 General

The installation of the SWTD shall conform to all applicable national, state, state highway, municipal and local specifications.

04.02.00 Installation

The Contractor shall furnish all labor, equipment, materials and incidentals required to install the (SWTD) device(s) and appurtenances in accordance with the drawings and these specifications.

- 04.02.01 Grading and Excavation site shall be properly surveyed by a registered professional surveyor, and clearly marked with excavation limits and elevations. After site is marked it is the responsibility of the contractor to contact local utility companies and/or DigAlert to check for underground utilities. All grading permits shall be approved by governing agencies before

- commencement of grading and excavation. Soil conditions shall be tested in accordance with the governing agencies requirements. All earth removed shall be transported, disposed, stored, and handled per governing agencies standards. It is the responsibility of the contractor to install and maintain proper erosion control measures during grading and excavation operations.
- 04.02.02 Compaction – All soil shall be compacted per registered professional soils engineer's recommendations and per governing agencies standards, prior to installation of SWTD.
- 04.02.03 Backfill shall be placed according to a registered professional soils engineer's recommendations and per governing agencies standards, and with a minimum of 6" of gravel under all concrete structures.
- 04.02.04 Concrete Structures – After backfill has been inspected by the governing agency and approved the concrete structures shall be lifted and placed in proper position per plans.

04.03.00 Shipping, Storage and Handling

- 04.03.01 Shipping – SWTD shall be shipped to the contractor's address or job site, and is the responsibility of the contractor to offload the unit(s) and place in the exact site of installation.
- 04.03.02 Storage and Handling– The contractor shall exercise care in the storage and handling of the SWTD and all components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be born by the contractor. The SWTD(s) and all components shall always be stored indoors and transported inside the original shipping container until the unit(s) are ready to be installed. The SWTD shall always be handled with care and lifted according to OSHA and NIOSA lifting recommendations and/or contractor's workplace safety professional recommendations.

04.04.00 Maintenance and Inspection

- 04.04.01 Inspection – After installation, the contractor shall demonstrate that the SWTD has been properly installed at the correct location(s), elevations, and with appropriate components. All components associated with the SWTD and its installation shall be subject to inspection by the engineer at the place of installation. In addition, the contractor shall demonstrate that the SWTD has been installed per the manufacturer's specifications and recommendations. All components shall be inspected by a qualified person once a year and results of inspection shall be kept in an inspection log.
- 04.04.02 Maintenance – The manufacturer recommends cleaning and debris removal and replacement of the storm booms as needed. The maintenance shall be preformed by someone qualified. A Maintenance Manual is available upon request from the manufacturer. The manual has detailed information regarding the maintenance of the SWTD. A Maintenance/Inspection record shall be kept by the maintenance operator. The record shall include any maintenance activities preformed, amount and description of debris collected, and the condition of the storm booms.
- 04.04.03 Material Disposal - All debris, trash, organics, and sediments captured by the SWTD shall be transported and disposed of at an approved facility for disposal in accordance with local and state requirements. Please refer to state and local regulations for the proper disposal of toxic and non-toxic material.



PART 5 – QUALITY ASSURNACE

05.01.00 Warranty

The Manufacturer shall guarantee the SWTD against all manufacturing defects in materials and workmanship for a period of (5) years from the date of delivery to the _____. The manufacturer shall be notified of repair or replacement issues in writing within the warranty period. The SWTD is limited to recommended application for which it was designed.

05.02.00 Performance Certification

The SWTD manufacturer shall submit to the Engineer of Record a "Manufacturer's Performance Certificate" certifying the SWTD is capable of achieving the specified removal efficiency for suspended solids as typically found in storm water runoff. The SWTD manufacture shall also provide a certification from a Licensed Civil Engineer that the SWTD unit(s) will remove a minimum of 80% of total suspended solids (of the size fractions typical for urban runoff or as required by local regulations) from the design flow rate. Devices with out these performance certifications will not be accepted.

END OF SECTION



Modular Wetland System Specifications
(Media Filter & Wetland/Bioretenention)





Section [_____] Modular Subsurface Flow Wetland System

PART 1 – GENERAL

01.01.00 Purpose

The purpose of this specification is to establish generally acceptable criteria for Modular Subsurface Flow Wetland Systems used for biofiltration of stormwater runoff including dry weather flows and other contaminated water sources. It is intended to serve as a guide to producers, distributors, architects, engineers, contractors, plumbers, installers, inspectors, agencies and users; to promote understanding regarding materials, manufacture and installation; and to provide for identification of devices complying with this specification.

01.02.00 Description

Modular Subsurface Flow Wetland Systems (MSFWS) are used for filtration of stormwater runoff including dry weather flows. The MSFWS is a pre-engineered biofiltration system composed of a manufactured pretreatment device containing multiple filtration cartridges, water transfer system, a modular subsurface flow wetland utilizing vegetative sorptive filter media bed, an innovative vegetation establishment media, vegetation and a flow control discharge device. Treated water flows horizontally through the separation portion of the pretreatment device, filtration cartridges and vegetative sorptive filter media bed and travels outwardly to the flow control discharge device.

01.03.00 Manufacturer

The manufacturer of the MSFWS pretreatment device, water transfer system, and flow control discharge device shall be one that is regularly engaged in the engineering design and production of systems developed for the treatment of stormwater runoff for at least (10) years, and which have a history of successful production, acceptable to the engineer of work. In accordance with the drawings, the MSFWS(s) shall be a filter device Manufactured by Bio Clean Environmental Services, Inc., or Modular Wetland Systems, Inc., or assigned distributors or licensees. Bio Clean Environmental Services Inc., and Modular Wetland Systems, Inc., can be reached at:

Corporate Headquarters:
Bio Clean Environmental Service, Inc.
2972 San Luis Rey Road
Oceanside, CA 92058
Phone: (760) 433-7640
Fax: (760) 433-3176
www.biocleanenvironmental.net

Corporate Headquarters:
Modular Wetland Systems, Inc.
P.O. Box 869
Oceanside, CA 92049
Phone: (760) 433-7650
www.modularwetlands.net

01.04.00 Submittals

- 01.04.01 Shop drawings are to be submitted with each order to the contractor and consulting engineer.
- 01.04.02 Shop drawings are to detail the MSFWS and all components required and the sequence for installation, including:
 - System configuration with primary dimensions
 - Interior components
 - Any accessory equipment called out on shop drawings
- 01.04.03 Inspection and maintenance documentation submitted upon request.

01.05.00 Work Included

- 01.05.01 Specification requirements for installation of MSFWS.
- 01.05.02 Manufacturer to supply components of the MSFWS(s):
 - Pretreatment device (pre-assembled)
 - Concrete Structure(s)
 - Water transfer system
 - Flow control discharge device (pre-assembled)
 - Vegetative Sorptive filter media bed

01.06.00 Reference Standards

ASTM C 29	Standard Test Method for Unit Weight and Voids in Aggregate
ASTM C 88	C 88 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C131	C 131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregates by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 330	C 330 Standard Specification for Lightweight Aggregate for Structural Concrete
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft.-lbf/ft ³ (600 kN-m/m ³))
ASTM D 1621	10 Standard Test Method for Compressive Properties Of Rigid Cellular Plastics
ASTM D 1777	ASTM D1777 - 96(2007) Standard Test Method for Thickness of Textile Materials
ASTM D 4716	Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
AASHTO T 99-01	Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in) Drop
AASHTO T 104	Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T 260	Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials.
AASHTO T 288	Standard Method of Test for Determining Minimum Laboratory Soil Resistivity
AASHTO T 289	Standard Method of Test for Determining ph of Soil for Use in Corrosion Testing
AASHTO T 291	Standard Method of Test for Determining Water Soluble Chloride Ion Content in Soil
AASHTO T 290	T 290 Standard Method of Test for Determining Water Soluble Sulfate Ion Content in Soil

PART 2 – COMPONENTS

The Modular Subsurface Flow Wetland Systems (MSFWS) and all of its components shall be self-contained within a concrete structure constructed of concrete with a minimum 28 day compressive strength of 5,000 psi, with reinforcing per ASTM A 615, Grade 60, and supports and H2O loading as indicated by AASHTO. Each Chamber shall have appropriate access hatches for easy maintenance and sized to allow removal of all internal components without disassembly. All water transfer system components shall conform with the following;

- Filter netting shall be 100% Polyester with a number 16 sieve size, and strength tested per ASTM D 3787.
- Drainage cells shall be manufactured of lightweight injection-molded plastic and have a minimum compressive strength test of

6,000 psi and a void area along the surface making contact with the filter media of 75% or greater. The cells shall be at least 2" in thickness and allow water to freely flow in all four directions.

02.01.00 Pretreatment Device Components

- 02.01.01 Filter Cartridges shall have a minimum 35 square feet of surface area per cartridge. The filter media contained in the cartridge should be solid in state (not granular) with a void percentage of equal to or greater than 80% and be composed materials listed in section 03.01.05.
- 02.01.02 Pervious Pavers shall be manufactured of natural stone pavers that have a minimum flow through rate of one gallon per second per square foot. The pervious pavers shall be approximately 2" in thickness.
- 02.01.03 Drain Down System shall be designed to completely drain all standing water in the pretreatment chamber in between storm events. The drain down system must include a weep hole(s) for infiltration.

02.02.00 Subsurface Flow Wetland

- 02.02.01 Media shall consist of structural light weight aggregates made of ceramic material produced by expanding and vitrifying select shales, clays, and slates in a rotary kiln. This process produces a high quality ceramic aggregate that is structurally strong, physically stable, durable, environmentally inert, light in weight, and highly insulative. It is a natural, non-toxic, absorptive aggregate that is dimensionally stable and will not degrade over time. Media must be produced to meet the requirements of ASTM C330, ASTM C331, and AASHTO M195. Aggregates must have a minimum 24-hour water absorption of 10.5% mass.
- 02.02.02 Planting shall be native, drought tolerant species recommend by manufacturer and/or landscape architect.
- 02.02.03 Plant Support Media shall be made of a 3" thick moisture retention cell that is inert and contains no chemicals or fertilizers.

02.03.00 Discharge device

The discharge device shall house a flow control orifice plate that restricts flows greater than designed treatment flow rate. All piping components shall be made of a high-density polyethylene.

PART 3 – PERFORMANCE

03.01.00 General

- 03.01.01 Function - The MSFWS has no moving internal components and functions based on gravity flow, unless otherwise specified. The MSFWS is composed of a pretreatment device, influent and effluent water transfer systems, vegetated sorptive subsurface flow wetland filtration bed and a flow control discharge device. The pretreatment device houses cartridge media filters, which consist of solid state filter media housed in a perforated enclosure. The untreated runoff flows into the system via subsurface piping and or a curb inlet. Water entering the system is forced through the filter cartridge enclosures by gravity flow. Then the flow contacts the filter media. The flow through the media is horizontal toward the center of each piece of rectangular media. In the center of the media shall be a round slotted PVC pipe of no greater than 1" in diameter. The slotted PVC pipe shall extend downward into

the Water Transfer Cavity. The slotted PVC pipe shall be threaded on the bottom to connect to the water transfer cavity. After pollutants have been removed by the filter media the water discharges the pretreatment chamber and flows into the water transfer system and is conveyed to the wetland chamber. Once runoff has been filtered by the sorptive media in the wetland chamber it is collected by a water collection system and conveyed to a discharge device equipped with a flow control orifice plate. Finally the treated flow is discharged to a municipal separate storm sewer system.

- 03.01.02 Pollutants - The MSFWS will remove and retain debris, sediments, TSS, dissolved and particulate metals and nutrients including nitrogen and phosphorus species, bacteria, BOD, TOC, oxygen demanding substances, organic compounds and hydrocarbons entering the filter during frequent storm events and continuous dry weather flows.
- 03.01.03 Treatment Flow Rate and Bypass - The MSFWS operates in-line. The MSFWS will treat 100% of the required water quality treatment flow based on a minimum filtration capacities listed in section 03.02.00. The size of the system must match those provided on the drawing to ensure proper performance and hydraulic residence time.
- 03.01.04 Pollutant Load – The MSFWS pretreatment device must be designed to have minimum storage capacity of 23.5 cubic feet of solids.
- 03.01.05 Filter Media Performance Protocol and Results - The filter media utilized in the pretreatment device must be tested by an independent third party consultant and laboratory to determine the hydraulic conductivity and the pollutant removal capability. The filter media shall be capable of capturing a minimum of 85.35% TSS (mean particle size 20 microns) using a sil-co-sil 106 particle size distribution or similar. The filter media must be composed of the following:

Silicon dioxide	SiO ₂	47%
Aluminum oxide	Al ₂ O ₃	14%
Titanium oxide	TiO ₂	1%
Ferrous oxide	FeO	8%
Calcium oxide	CaO	16%
Magnesium oxide	MgO	10%
Manganese oxide	MnO	1%
Sodium oxide	Na ₂ O	2%
Potassium oxide	K ₂ O	1%

03.02.00 Lab Test Performance

At a minimum, the MSFWS shall meet these performance standards:

Removal efficiencies from an independent third party:

- TSS – 85.35% (mean particle size 20 microns)
- Dissolved Phosphorus – 69.66%
- Dissolved Copper – 79.15%
- Dissolved Lead – 98.19%
- Dissolved Zinc – 78.22%
- Oils & Grease – 90.70%
- TPH – 99.99%
- Turbidity – 99.19%
- Fecal Coliform – 68.00%

Physical Specifications

- Density (kg/dm³) of Filter Media 0.046
- Porosity (%) of Filter Media 97.6
- Filter Media Hydraulic Conductivity 0.00464 m/s = 400.896 m/d (test 1) / Hydraulic Conductivity 363 m/d (test 2)

Minimum Treatment Capabilities

- System must be capable of treating flows to the specified treatment flow rate on the drawings. The flow rate shall be controlled by an orifice plate.

PART 4 - EXECUTION

04.01.00 General

The installation of the MSFWS shall conform to all applicable national, state, state highway, municipal and local specifications.

04.02.00 Installation

The Contractor shall furnish all labor, equipment, materials and incidentals required to install the (MSFWS) device(s) and appurtenances in accordance with the drawings and these specifications.

- 04.02.01 Grading and Excavation site shall be properly surveyed by a registered professional surveyor, and clearly marked with excavation limits and elevations. After site is marked it is the responsibility of the contractor to contact local utility companies and/or DigAlert to check for underground utilities. All grading permits shall be approved by governing agencies before commencement of grading and excavation. Soil conditions shall be tested in accordance with the governing agencies requirements. All earth removed shall be transported, disposed, stored, and handled per governing agencies standards. It is the responsibility of the contractor to install and maintain proper erosion control measures during grading and excavation operations.
- 04.02.02 Compaction – All soil shall be compacted per registered professional soils engineer's recommendations prior to installation of MSFWS components.
- 04.02.03 Backfill shall be placed according to a registered professional soils engineer's recommendations, and with a minimum of 6" of gravel under all concrete structures.
- 04.02.04 Concrete Structures – After backfill has been inspected by the governing agency and approved the concrete structures shall be lifted and placed in proper position per plans.
- 04.02.05 Subsurface Flow Wetland Media shall be carefully loaded into area so not to damage the Wetland Liner or Water Transfer Systems. The entire wetland area shall be filled to a level 9 inches below finished surface.
- 04.02.06 Planting layer shall be installed per manufacturer's drawings and consist of a minimum 3" grow enhancement media that ensures greater than 95% plant survival rate, and 6" of wetland media. Planting shall consist of native plants recommended by manufacturer and/or landscape architect. Planting shall be drip irrigated for at least the first 3 months to insure long term plant growth. No chemical herbicides, pesticides, or fertilizers shall be used in the planting or care and maintenance of the planted area.

04.03.00 Shipping, Storage and Handling

- 04.03.01 Shipping – MSFWS shall be shipped to the contractor’s address or job site, and is the responsibility of the contractor to offload the unit(s) and place in the exact site of installation.
- 04.03.02 Storage and Handling– The contractor shall exercise care in the storage and handling of the MSFWS and all components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be born by the contractor. The MSFWS(s) and all components shall always be stored indoors and transported inside the original shipping container until the unit(s) are ready to be installed. The MSFWS shall always be handled with care and lifted according to OSHA and NIOSA lifting recommendations and/or contractor’s workplace safety professional recommendations.

04.04.00 Maintenance and Inspection

- 04.04.01 Inspection – After installation, the contractor shall demonstrate that the MSFWS has been properly installed at the correct location(s), elevations, and with appropriate components. All components associated with the MSFWS and its installation shall be subject to inspection by the engineer at the place of installation. In addition, the contractor shall demonstrate that the MSFWS has been installed per the manufacturer’s specifications and recommendations. All components shall be inspected by a qualified person once a year and results of inspection shall be kept in an inspection log.
- 04.04.02 Maintenance – The manufacturer recommends cleaning and debris removal maintenance of once a year and replacement of the Cartridge Filters as needed. The maintenance shall be preformed by someone qualified. A Maintenance Manual is available upon request from the manufacturer. The manual has detailed information regarding the maintenance of the MSFWS. A Maintenance/Inspection record shall be kept by the maintenance operator. The record shall include any maintenance activities preformed, amount and description of debris collected, and the condition of the filter.
- 04.04.03 Material Disposal - All debris, trash, organics, and sediments captured by the MSFWS shall be transported and disposed of at an approved facility for disposal in accordance with local and state requirements. Please refer to state and local regulations for the proper disposal of toxic and non-toxic material.

PART 5 – QUALITY ASSURNACE

05.01.00 Warranty

The Manufacturer shall guarantee the MSFWS against all manufacturing defects in materials and workmanship for a period of (5) years from the date of delivery to the _____. The manufacturer shall be notified of repair or replacement issues in writing within the warranty period. The MSFWS is limited to recommended application for which it was designed.

05.02.00 Performance Certification

The MSFWS manufacturer shall submit to the Engineer of Record a “Manufacturer’s Performance Certificate” certifying the MSFWS is capable of achieving the specified removal efficiency for suspended solids of at least 85% with a mean particle size of 20 microns.

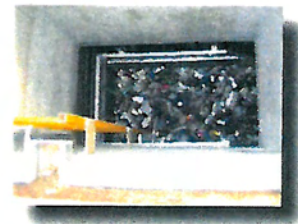
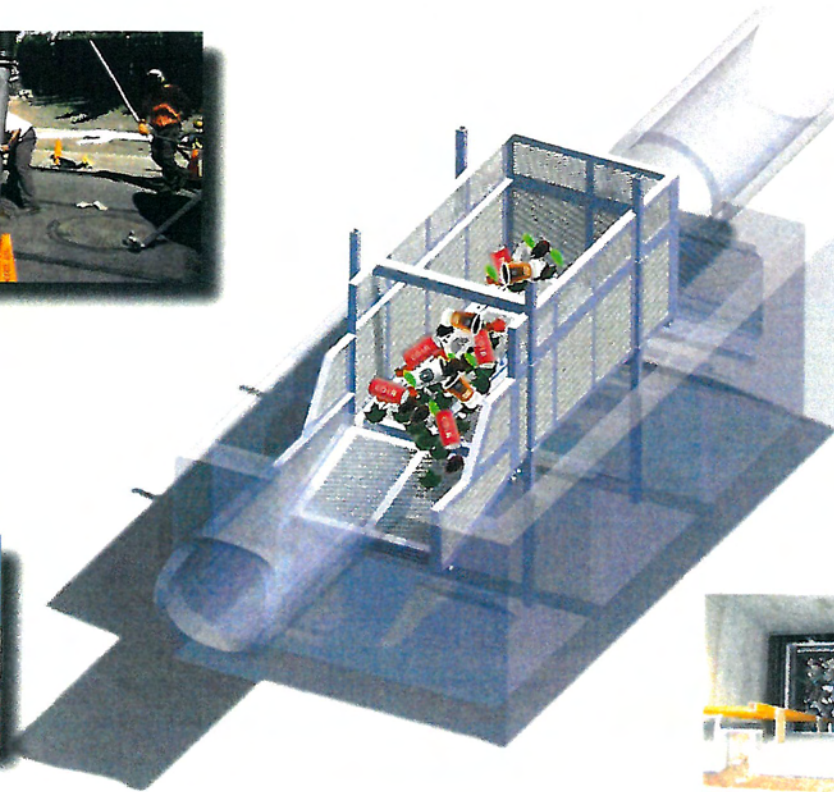
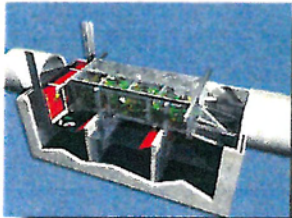


Bio Clean Dual Stage Hydrodynamic Separator O & M
(Vortex Separator with Elevated Screen System)



OPERATION & MAINTENANCE

Nutrient Separating Baffle Box™ A Complete Stormwater Filtration System



Bio Clean Environmental Services, Inc.
P.O. Box 869
Oceanside, CA 92049

www.biocleanenvironmental.com
P 760-433-7640
F 760-433-3176

OPERATION & MAINTENANCE

Maintenance Summary –

- Clean screening basket. Typical service interval occurs once every 12 months (*60 minute service time*).
- Clean separation chambers. Typical service interval occurs once every 12 months (*60 minute service time*).
- Replace hydrocarbon media booms. Typically replacement occurs once every 12 months (*15 minute service time*).

Notes:

- Loading Varies at Every Location Due to Variations in Pollutant and Flow Volumes.
- Maintenance Typically Occurs Before and After the Rainy Season.
- Hydrocarbon Booms and Replacement Parts Can Be Provided By Bio Clean Environmental Services, Inc.

Maintenance Procedures –

A. Following the installation of a Nutrient Separating Baffle Box the unit will require periodical maintenance. Maintenance can be provided by the Supplier, or a Supplier approved contractor. The cost of this service varies among providers.

B. The Nutrient Separating Baffle Box is a multi-stage, self-contained treatment train. Each stage protects subsequent stages from clogging. These stages include: screening, separation and absorption.

1. Screening is provided by a rectangular basket suspended above the standing water level of the sedimentation chambers. This screening filter has a storage capacity of several cubic yards depending on the model. This screening basket captures gross solids including litter and sediments. **It is recommended that this screening filter be inspected every 6 months and cleaned every 12 months depending on loading.** Cleaning of this device is relatively inexpensive. *This procedure takes approximately 60 minutes and can be done with a vac truck.*

2. Separation is provided by three settling chambers. These chambers have a capacity of several cubic yards depending. These chambers target smaller sediments, larger TSS, and particulate metals and nutrients. **It is recommended that this separation chamber be inspected every 6 months and cleaned every 12 months.** This procedure can be performed with a standard vacuum truck. *This procedure takes approximately 60 minutes.*

3. Primary absorption is provided by hydrocarbon booms. The hydrocarbon booms are housed within a metal cage attached to the influent side of the weir. This device removes free floating and emulsified hydrocarbons from water. **It is recommended that the hydrocarbon booms be inspected every 6 months and replaced every 12 months.** Replacement of the hydrocarbon booms is simple and should be disposed of in accordance with local and state regulations. *Replacement of the hydrocarbon booms take approximately 15 minutes.*

The Nutrient Separating Baffle Box's screening basket, separation chambers and hydrocarbon cage are designed to allow for the use of vacuum removal of captured materials in the screening basket and sediment chambers. These are serviceable by centrifugal compressor vacuum units without causing damage to the system or during normal cleaning and maintenance. Screening basket and sediment chambers can be cleaned and vacuumed from the standard manhole access or at grade.

Maintenance Notes:

1. Bio Clean Environmental Services, Inc. recommends the **screening basket** be inspected every 6 months and cleaned every 12 months depending on loading. The procedure is easily done with the use of any standard vacuum truck.
 - Remove all manhole covers (or open hatches) to gain access to the screening basket. Remove all trash, debris, organics, and sediments captured by the screening basket. Removal of the trash and debris can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screen of the filter. A pressure washer may be needed to remove debris stuck to the screening basket.
 - Remove vacuum hose and replace manhole covers or hatch doors.

- Where possible the maintenance should be performed from the ground surface.
- Note: entry into an underground stormwater vault such as an inlet vault requires certification of confined space training.
- Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

2. Bio Clean Environmental Services, Inc. recommends the **separation chambers** be inspected every 6 months and cleaned every 12 months depending on loading. The procedure is easily done with the use of any standard vacuum truck.

- Remove all manhole covers (or open hatches) to gain access to the separation chambers.
- The screening basket must be cleaned prior to cleaning the separation chambers. The bottom of the screening basket is designed with 3 hinged panels that are lifted up to gain access to the separation chambers. Once the panels are lifted to a vertical position, unimpeded access to the three separation chambers is provided.
- Use a vacuum truck hose and insert into the manhole or hatch opening. Lower the vacuum hose through the screening basket and into the first of the three separation chambers, closest to the inflow pipe. Begin vacuuming out accumulated sediments and standing water until the chamber is empty. A pressure washer may be needed to assist with removing sediments that are compacted or stuck to the walls and floor of the separation chamber.
- Repeat process in all three separation chambers.
- Once the chambers are cleaned remove vacuum hose and lower hinged panels of screening basket back to a horizontal position.
- Remove vacuum hose and replace manhole covers or hatch doors.
- Where possible the maintenance should be performed from the ground surface.
- Note: entry into an underground stormwater vault such as an inlet vault requires certification of confined space training.
- Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

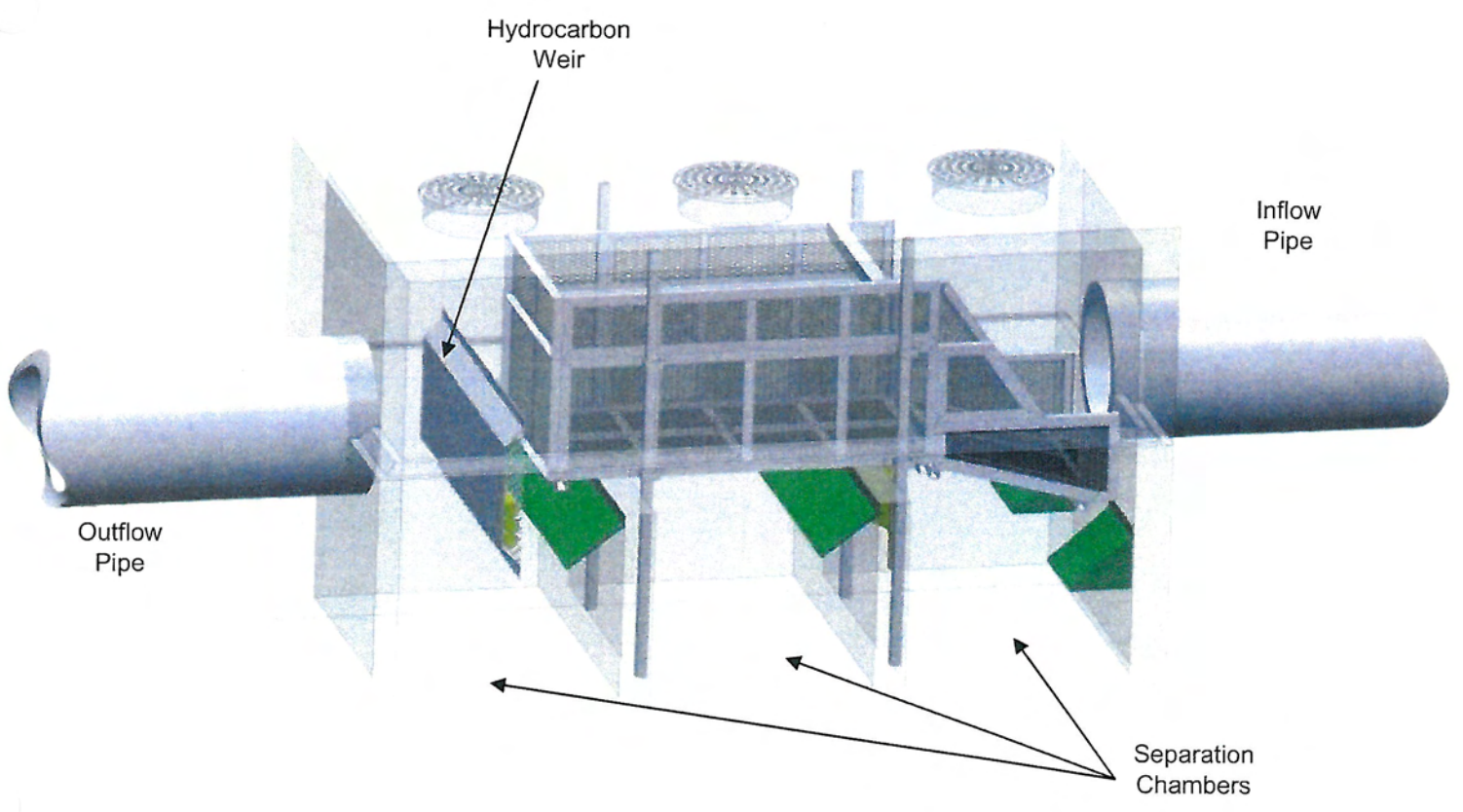
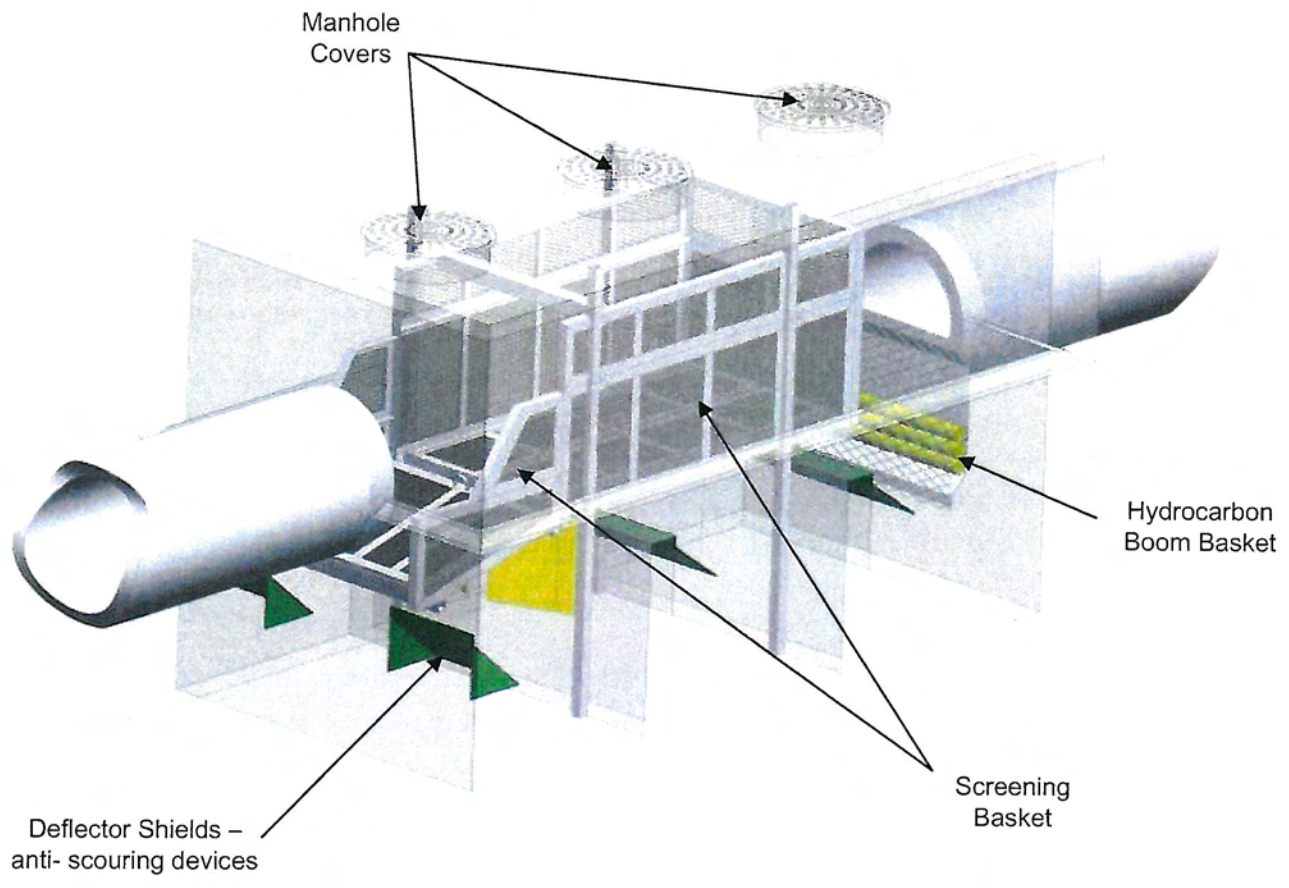
3. Bio Clean Environmental Services, Inc. recommends the hydrocarbon booms be inspected every 6 months and cleaned/replaced every 12 months depending on loading. The procedure will require prior maintenance of separation chambers and screening basket.

- Remove manhole cover (or open hatch) closest to the outflow end of the system to gain access to the hydrocarbon boom cage.
- Enter the manhole closest to the outflow pipe. Always use appropriate safety gear and procedures and follow local regulations.
- On the influent side of the weir is a small media cage containing hydrocarbon booms. Open top. Remove old hydrocarbon booms and replace with new hydrocarbon booms. Close top (If the boom is filled with hydrocarbons and oils it should be replaced).
- Exit the vault.
- Note: entry into an underground stormwater vault such as an inlet vault requires certification of confined space training.
- Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Following maintenance and/or inspection, the maintenance operator shall prepare a maintenance/inspection record. The record shall include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanism.

5. The owner shall retain the maintenance/inspection record for a minimum of five years from the date of maintenance. These records shall be made available to the governing municipality for inspection upon request at any time.

6. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.



Maintenance Sequence



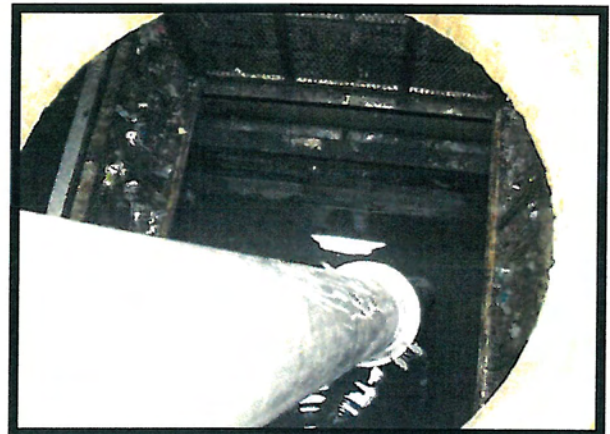
Remove All Manhole Covers or Open Hatch Doors. Hatch Doors Available at Additional Cost.



Assess Condition and Pollutant Loading Through Visual Inspection. Look at Trash & Sediment Loading.



Insert Vacuum Hose to Remove Trash & Debris from the Screening Basket.



Open Screen Panels & Insert Hose into First Separation Chamber to Remove Sediments. Repeat in All Three Chambers.



If Sediments are Compacted Use a Pressure Washer to Loosen Up Sediments.



Remove Old Hydrocarbon Booms & Replace with New Ones.



Inspection and Maintenance Report Nutrient Separating Baffle Box

Project Name _____

Project Address _____ (city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone () - _____

Inspector Name _____ Date ____ / ____ / ____ Time _____ AM / PM

Type of Inspection Routine Follow Up Complaint Storm Storm Event in Last 72-hours? No Yes

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date) Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Vault	Model #	Trash & Foliage Accumulation in Screen Basket (lbs)	Sediment Accumulation - Chamber 1 (lbs)	Sediment Accumulation - Chamber 2 (lbs)	Sediment Accumulation - Chamber 3 (lbs)	Condition of Hydrocarbon Booms 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: _____ Long: _____							
	Lat: _____ Long: _____							
	Lat: _____ Long: _____							

Comments: _____

For Questions and Technical Support Please Call Our Friendly
Support Staff at: 760-433-7640

All Filtration Media, Hydrocarbon Booms and Replacement Parts
Can Be Ordered from Bio Clean Environmental.

All Components Can Be Replaced.

